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10/797,800	03/10/2004	Hideaki Komatsu	JP920030038US1	4524

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EXAMINER	
NGUYEN, PHILLIP H	
ART UNIT	PAPER NUMBER
2191	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/23/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/797,800	KOMATSU ET AL.	
	Examiner	Art Unit	
	Phillip H. Nguyen	2191	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 March 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *10 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☒ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *20041208,20050330,20061027*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. This action is in response to the original filing of March 12, 2003. Claims 1-25 are pending and have been considered below.

Note

2. Regarding claims 1, 5-9, 13, 16, and 17,recites the phrase "for" in the body of the claim. It indicates intended use and as such does not carry any patentable weight. The limitations following the phrase "for" describes on intended use but not necessarily required functionality of the claim. Applicant is suggested to amend the claim so that the claim limitations are recited in a definite form. For example, "a loop process detection portion for detecting" should be changed to "a loop process detection portion to detect" or "...that detects" or any other definite form.

3. Applicant appears to be attempting to invoke 35 U.S.C. 112 6th paragraph in claims 19, 20, 22, and 24 by using "means plus function" language. However, Examiner notes that the only "means" for performing these cited functions is software ("computer readable program code"). The claims have not invoked 35 U.S.C. 112 6th paragraph. Further more, the claims recite sufficient structure, which is "computer readable program code" for performing these cited functions. While the claims pass the first of the three-prong test used to determine invocation of paragraph 6, since it also recites sufficient structure within the claim itself to perform entirely recited functions, the claims are not in means-plus-function format, even if the claims use the term "means."

Therefore, 35 U.S.C. 112 6th paragraph has not been invoked when considering these claims below.

Claim Rejections - 35 USC § 101

1. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

2. Claims 1-13, 16, 18, and 19 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

- Regarding claims 1, 16, recite an apparatus but it appears reasonable to interpret this apparatus by one of ordinary skill in the art as software per se. Applicant's specification provides no explicit and deliberate definition of the components ("a loop process detection portion", "a loop process frequency collection portion", "an in-loop process frequency collection portion", "an in-loop execution information generating portion", and "an optimization portion") that make up the apparatus other than they could be software components, which are directed to functional descriptive material, per se, and are therefore non-statutory. Further more, it recites the phrase "for" in the body of the claim, which indicates intended use and as such does not carry any patentable weight. The limitations following the phrase "for" describe only intended use but not necessarily required functionality of the claim. Limitations following the phrase "for" do not carry patentable weight, which cause the claim to appear as a series of non-functional descriptive material/data without any functional relation with each other. Claim should be

amended to recite "to detect" or "that detects" or any definite form. Claims 2-12, 19, and 22 directly or indirectly depend on claims 1 and 16 respectively, and therefore, have been addressed in connection with the rejection set forth to claim 1 and 16.

- Regarding claims 13 and 17, recite a program, which directed to software, lacking storage on a medium, which enables any underlying functionality to occur. Further more, they recite the phrase "for" in the body of the claim, which indicates intended use and as such does not carry any patentable weight. The limitations following the phrase "for" describe only intended use but not necessarily required functionality of the claim. Limitations following the phrase "for" do not carry patentable weight, which cause the claim to appear as a series of non-functional descriptive material/data without any functional relation with each other. Claims should be amended to recite "to detect" or "that detects" or any definite form.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 2, 14, 18-22, 24, and 25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

- Regarding claims 14 and 18, they are unclear to Examiner whether these claims are record medium claims or program claims. It appears to Examiner that claims 14 and 18 depend on claim 13 and 17 respectively, and therefore, for examining purposes, Examiner interprets them as program claims.
- Regarding claims 12 and 22, they are unclear to Examiner whether these claims are apparatus claims or computer program product claims. It appears to Examiner that claim 12 depends on claim 1 and claim 22 depends on 16, and therefore, Examiner interprets it as apparatus claims.
- Regarding claims 20 and 24, it is unclear to Examiner whether these claims are article of manufacture or method claims. For examining purposes, Examiner interprets it as method claims.
- Regarding claim 20, it is unclear to Examiner whether this claim is storage device claim or a method claim. It appears to Examiner that it depends on claim 15, and therefore, Examiner interprets it as a method claim.
- Regarding claims 21 and 25, it is unclear to Examiner whether these claims are storage device claims or a method claims. For examining purposes, Examiner interprets it as method claims.
- Regarding claim 22, it is unclear to Examiner whether it is a computer program product or an apparatus claim. For examining purposes, Examiner interprets it as apparatus claim.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-4 and 13-25 are rejected under 35 U.S.C. 102(b) as being anticipated by Wu (United States Patent No.: 5,655,122).

As per claims 1 and 13-25:

Wu discloses

- a loop process detection portion for detecting a repeatedly executed loop process of said program ("**a procedure's flow graph with two loop heads, one of which is nested in the other**" col. 11, line 51-52);
- a loop process frequency collection portion for collecting loop process frequencies with which said loop process is executed in said program ("**compute frequencies for the outer loops**" col. 11, line 67);
- an in-loop process frequency collection portion for collecting in-loop process frequencies with which, as against the number of times of execution of said loop process, each of a plurality of in-loop processes included in said loop process is executed ("...**find the frequency of the inner loop head**..." col. 11, line 53-62);
- an in-loop execution information generating portion for, based on said loop process frequencies and said in-loop process frequencies, generating in-loop

execution information indicating the frequencies with which each of said plurality of in-loop processes is executed in the case where said program is executed ("**the cyclic probabilities of inner loops are used to compute frequencies for the outer loops**" col. 11, line 66-67, **cyclic probabilities of the inner loops are calculated first and contain the frequencies of the inner loops**); and

- an optimization portion for optimizing said program based on said in-loop execution information generated by said in-loop execution information generating portion ("**code generator 64 to optimize the object code**..." col. 12, line 62-67 – col. 13, line 1-4; also see FIG. 2).

As per claim 2:

Wu discloses:

- wherein said in-loop process frequency collection portion collects said in-loop process frequencies in the case where said loop process frequencies are higher than a predetermined frequency (**It is inherent in Wu in order to optimize the program**).

As per claim 3:

Wu discloses:

- wherein said in-loop execution information generating portion generates said in-loop execution information by multiplying said loop process frequencies by said in-loop process frequencies (**It is inherent because in order to get the total**

execution frequencies, one must multiply inner loop frequencies by the outer loop frequencies).

As per claim 4:

Wu discloses:

- said loop process is an outer loop process including an inner loop process which is a further inside loop process ("**two loop heads, one of which nested in the other**" col. 11, line 51-52);
- said loop process detection portion further detects said inner loop process ("...**the most inner loop is visited first**..." col. 11, line 66);
- said loop process frequency collection portion collects the loop process frequencies with which said inner loop process is executed in said program based on said in-loop execution information ("**the cyclic probabilities of inner loops are used to compute frequencies for the outer loops**" col. 11, line 66-67);
- said in-loop process frequency collection portion further collects the in-loop process frequencies of said inner loop process ("...**find the frequency of the inner loop head**..." col. 11, line 53-62); and
- said in-loop execution information generating portion generates the in-loop execution information on said inner loop process by multiplying the in-loop process frequencies in said inner loop process by said loop process frequencies of said inner loop process (**It is inherent because in order to get the total**

execution frequencies, one must multiply inner loop frequencies by the outer loop frequencies).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 5-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (United States Patent No.: 5,655,122), in view of Peri (United States Patent No.: 6,088,525).

As per claim 5:

Wu does not explicitly disclose:

- said loop process frequency collection portion stops a counter for determining the number of times of execution of said loop process when said program is executed a predetermined number of times so as to collect the number of times determined by the counter as said loop process frequencies; and
- said in-loop process frequency collection portion stops the counter for determining the number of times of execution of each of said plurality of in-loop processes when a total of determined values of said plurality of in-loop processes becomes the predetermined number of times.

However, Peri discloses placing instrumentation slots at every entry point for the loop and also at every exit point for the loop (see at least FIG. 4). Therefore, it would have been obvious to one having an ordinary skill in the art at the time the invention was made to modify Wu's approach to instrument the program to collect execution information. One would have been motivated to insert instrument code into the program because instrumentation is simple and low-cost and it minimizes its overhead. Further more, by placing the instrumentation slots at the entry points and exit points outside the loop, and consequently, accurate information about the loop execution can be readily determined.

As per claim 6:

Wu discloses:

- a control flow graph generating portion for generating a control flow graph in which each of a plurality of instruction sequences in said program is generated as a node and an execution order of said plurality of instruction sequences is generated as a directed edge of said nodes ("**a control flow graph of a procedure...the graph is comprised of a group of nodes, which are the basic blocks of a function, and edges, which are the branches**..." col. 5, line 33-42);
- a structure graph generating portion for, in said control flow graph, generating an outline structure graph in which a single loop node for showing said loop process in its entirety is generated instead of a collection of the nodes forming said loop

process and an in-loop structure graph which is the control flow graph of the collection of the nodes forming said loop process (**see at least col. 10, line 60-67, also see FIGS. 5A-C**);

- wherein said loop process frequency collection portion generates as said loop process frequencies the numbers of times of execution of said loop node as against the numbers of times of execution of said program ("**compute frequencies for the outer loops**" col. 11, line 67); and
- said in-loop process frequency collection portion collects as said in-loop process frequencies the number of times of execution of each execution path in said in-loop structure graph as against the numbers of times of execution of said loop process ("...**find the frequency of the inner loop head**..." col. 11, line 53-62).

Wu does not explicitly disclose:

- a counter insertion portion for, in each of said outline structure graph and said in-loop structure graph, inserting a counter into said program in order to count the number of times of execution of each execution path in the structure graphs.

However, Peri discloses:

- a counter insertion portion for, in each of said outline structure graph and said in-loop structure graph, inserting a counter into said program in order to count the number of times of execution of each execution path in the structure graphs ("**placing the instrumentation slots at the entry points and exit points outside the loop, and consequently, accurate information about the loop execution can be readily determined**" col. 3, line 13-17).

Therefore, it would have been obvious to one having an ordinary skill in the art at the time the invention was made to modify Wu's approach to instrument the program to count the execution frequency of control flow paths in a routine. One would have been motivated to modify because instrumentation is simple and low-cost and it minimizes its overhead.

As per claim 7:

Wu does not explicitly disclose:

- wherein: in the case where said program is executed a predetermined number of times, said loop process frequency collection portion collects as the loop process frequencies the determined values of the counter inserted for counting the number of times of execution of the execution paths including said loop node; and
- in the case where a total of the determined values of said plurality of in-loop processes becomes a predetermined number of times, said in-loop process frequency collection portion collects the in-loop process frequencies based on the determined values of the counter inserted for counting the number of times of execution of each execution path in said in-loop structure graph.

However, Peri discloses placing instrumentation slots at every entry point for the loop and also at every exit point for the loop (see at least FIG 4). Therefore, it would have been obvious to one having an ordinary skill in the art at the time the invention was made to modify Wu's approach to instrument the program to collect execution

information. Since, Wu discloses "the most inner loop is visited first" (col. 11, line 65-66), therefore the inner loop process frequency becomes a predetermined number. One would have been motivated to insert instrument code into the program because instrumentation is simple and low-cost and it minimizes its overhead. Further more, by placing the instrumentation slots at the entry points and exit points outside the loop, and consequently, accurate information about the loop execution can be readily determined.

As per claim 8:

Wu does not explicitly disclose:

- wherein in the case where an insertion position in said program for inserting the counter for determining the number of times of execution of each execution path in said outline structure graph is the same as the position in said program for inserting the counter for determining the number of times of execution of each execution path in said in-loop structure graph and then the counter of one, at the most, of said outline structure graph and said in-loop structure graph is started, said counter insertion portion inserts into the insertion position the counter for determining the numbers of times of execution of the execution paths in both said outline structure graph and said in-loop structure graph.

However, Peri discloses placing instrumentation slots at every entry point for the loop and also at every exit point for the loop (see at least FIG 4). Therefore, it would have been obvious to one having an ordinary skill in the art at the time the invention was made to modify Wu's approach to instrument the program to collect execution

information. One would have been motivated to insert instrument code into the program because instrumentation is simple and low-cost and it minimizes its overhead. Further more, by placing the instrumentation slots at the entry points and exit points outside the loop, and consequently, accurate information about the loop execution can be readily determined.

As per claim 9:

Wu does not explicitly discloses:

- wherein: in the case where an insertion position in said program for inserting the counter for determining the number of times of execution of each execution path in said outline structure graph is the same as the position in said program for inserting the counter for determining the number of times of execution of each execution path in said in-loop structure graph and then the counter of one, at the most, of said outline structure graph and said in-loop structure graph is started, said counter insertion portion generates a plurality of determination processes for determining the number of times of execution of each execution path in each of said outline structure graph and said in-loop structure graph; and
- said in-loop process frequency collection portion inserts a jump instruction for moving the process to another portion into said insertion position and sets a jump destination of the jump instruction at one of said plurality of determination processes so as to determine the numbers of times of execution of the execution

paths in both said outline structure graph and said in-loop structure graph (see at least FIG. 4).

However, Peri discloses placing instrumentation slots at every entry point for the loop and also at every exit point for the loop (see at least FIG 4). Therefore, it would have been obvious to one having an ordinary skill in the art at the time the invention was made to modify Wu's approach to instrument the program to collect execution information. One would have been motivated to insert instrument code into the program because instrumentation is simple and low-cost and it minimizes its overhead. Further more, by placing the instrumentation slots at the entry points and exit points outside the loop, and consequently, accurate information about the loop execution can be readily determined.

As per claim 10:

Wu discloses:

- said loop process is an outer loop process including an inner loop process which is a further inside loop process ("**two loop heads, one of which nested in the other**" col. 11, line 51-52);
- said loop process detection portion further detects said inner loop process ("...**the most inner loop is visited first**..." col. 11, line 66);
- in the control flow graph of said outer loop process, said structure graph generating portion generates as an in-outer loop structure graph a graph in which the single inner loop node is generated instead of a collection of the nodes

forming said inner loop process and generates an in-inner loop structure graph which is the control flow graph of the collection of the nodes forming said inner loop process (**see at least col. 10, line 60-67, also see FIGS. 5A-C**);

- said loop process frequency collection portion further collects the loop process frequencies with which said inner loop process is executed in said program based on said in-loop execution information ("**the cyclic probabilities of inner loops are used to compute frequencies for the outer loops**" col. 11, line 66-67);
- said in-loop process frequency collection portion collects the frequencies of execution of each execution path in said in-inner loop structure graph as the in-loop process frequencies of said inner loop process as against the number of times of execution of said inner loop process ("...**find the frequency of the inner loop head**..." col. 11, line 53-62); and
- said in-loop execution information generating portion further generates the in-loop execution information on said inner loop process by multiplying the in-loop process frequencies in said inner loop process by the loop process frequencies of said inner loop process ("**the cyclic probabilities of inner loops are used to compute frequencies for the outer loops**" col. 11, line 66-67, **cyclic probabilities of the inner loops are calculated first and contain the frequencies of the inner loops**).

Wu does not explicitly disclose:

- said counter insertion portion further inserts the counter for determining the number of times of execution of each execution path in the in-inner loop structure graph.

Peri discloses:

- Said counter insertion portion further inserts the counter for determining the number of times of execution of each execution path in the in-inner loop structure graph ("**placing the instrumentation slots at the entry points and exit points outside the loop, and consequently, accurate information about the loop execution can be readily determined**" col. 3, line 13-17).

Therefore, it would have been obvious to one having an ordinary skill in the art at the time the invention was made to modify Wu's approach to instrument the program to count the execution frequency of control flow paths in a routine. One would have been motivated to modify because instrumentation is simple and low-cost and it minimizes its overhead.

As per claims 11 and 12:

- recite the same limitations as recited in claims 8 and 9 respectively, and therefore, have been addressed in connection with the rejection set forth to claims 8 and 9 respectively.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- Wu (US 2002003/0204840 A1) discloses an apparatus and method for one-pass profiling to concurrently generate a frequency profile and a stride profile to enable data pre-fetching in irregular programs.
- Breternitz et al. (US 5,889,999) discloses an apparatus and a method for sequencing computer instruction execution in a data processing system.
- Tandri (US 6,341,371 B1) discloses system and method for optimizing program execution in a computer system.
- Ball et al. "Optimally Profiling and Tracing Programs".

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phillip H. Nguyen whose telephone number is (571) 270-1070. The examiner can normally be reached on Monday - Thursday 10:00 AM - 3:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wei Y. Zhen can be reached on (571) 272-3708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PN
03/29/2007

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